Subject: Final Minutes, Quarterly Restoration Advisory Board (RAB) Meeting
Longhorn Army Ammunition Plant (LHAAP)
Location of Meeting: Karnack Community Center, Karnack, Texas
Date of Meeting: April 19, 2018, 4:00 – 5:00 PM Central Daylight Time (CDT)

Meeting Participants:

Army BRAC:	Rose M. Zeiler
USACE:	Aaron Williams and Rick Smith
USAEC:	Andrew Maly
Bhate:	Kim Nemmers and Dustin McNeil
APTIM:	William (Bill) Foss
USEPA Region 6:	Rich Mayer, Dorelle Harrison
TCEQ:	April Palmie
USGS:	Kent Becher
RAB:	Present: Paul Fortune, Carol Fortune, Judy VanDeventer, Tom Walker, Charles Dixon, and Richard Le Tourneau Absent: Ken Burkhalter; Lee Guice; Ted Kurz; Terry Britt; James Lambright; John Pollard, Jr.; and Nigel R. Shivers
Public:	Laura-Ashley Overdyke, Katherine Edmonds, Robert Lanier, Sharon Metting, and Carl Dunn

An agenda for the RAB meeting, a color copy of the Bhate Environmental Associates, Inc. (Bhate) slide presentation, and handouts (see list at end of meeting minutes) were provided for meeting attendees.

Welcome and Introduction

Mr. Paul Fortune, RAB Co-Chair, called the meeting to order. Mr. Fortune noted new persons were at the RAB Meeting. Mr. Andrew Maly stated that he is with the United States Army Environmental Command (USAEC). Mr. Robert Lanier stated that he is a nearby home owner. Sharon Metting was also a noted as a new attendee.

Open Items

Ms. Rose Zeiler stated that the RAB Members were sent the minutes from the January 2018 meeting. Ms. Judy VanDeventer motioned for approval to which Mr. Paul Fortune seconded. Ms. Zeiler also noted that there were new people attending and that the use of technical terms may not be familiar to those people or even existing RAB Members. Ms. Zeiler suggested that a brief hydrogeology refresher be held at the next meeting, which was agreed to by others at the meeting.

Ms. Kim Nemmers mentioned that handouts were available and encouraged those that had not picked up these handouts to do so. Ms. Nemmers discussed the agenda as outlined and explained the abbreviations slide. Ms. Nemmers explained that the RAB Member form was available as a handout and encouraged those that might be interested in joining to take one. Mr. Fortune stated that public participation was encouraged.

Ms. Nemmers presented the website address for the LHAAP and stated that the site includes the final documents prepared and brief information about the sites. The feedback from the public has been positive for the website.

Ms. Nemmers explained the sites remaining to be remediated at LHAAP, and which sites are included under the Bhate project. Bhate is the prime contractor for all of the sites that are under a Record of Decision (ROD). Ms. Katherine Edmonds asked if there were any environmental experts at the RAB, to which Ms. Nemmers introduced Ms. April Palmie with the Texas Commission on Environmental Quality (TCEQ) and Mr. Rich Mayer with the United States Environmental Protection Agency (USEPA). Ms. Nemmers then explained that the sites to be discussed at the RAB would be those under the Bhate contract.

Defense Environmental Restoration

Overview of Sites

Ms. Nemmers discussed the documents being prepared and the field work that has been completed over the prior 3 months to move the sites forward. Ms. Nemmers explained that, under the new contract, a new work plan to cover all the work including health and safety and standard operating procedures (e.g. how to install a well) was prepared and is being finalized.

Ms. Nemmers explained two decision documents are being prepared to address LHAAP-03 soil and groundwater separately. Because the groundwater under Site 3 is indistinguishable from the groundwater plume under LHAAP-58, it will be addressed under the Site 58 remedy, which requires an explanation of significant difference (ESD). The LHAAP-03 ROD is being revised and will address only the contaminated soils at LHAAP-03. LHAAP-03 is located within LHAAP-58.

Ms. Nemmers explained that a lot of groundwater monitoring is performed to evaluate how the contamination is attenuating or how the remedies are performing. So, there are several documents being prepared to present that information for sites.

A Pre-Design Investigation, which has been discussed at previous meetings, was completed at Site LHAAP-17 to assess the soil impacts based upon more recent screening criteria to develop the design for that site. The LHAAP-17 pre-design investigation was completed with the exception of soil samples that were in a wet area.

A Groundwater Treatment Plant (GWTP) Report is also being prepared which will include surface water and Site LHAAP-18/24, which feeds groundwater to the GWTP.

Ms. Edmonds asked what the mercury level is at LHAAP. Ms. Zeiler asked if the reference was to levels of mercury in Caddo Lake. Ms. Edmonds stated that mercury was dumped into the lake. Ms. Zeiler stated that she was unaware of dumping, but that there was quite a bit of sediment testing conducted at Caddo Lake and the tributaries to identify hot spots, including along LHAAP. The results were that there was some mercury in sediment but at levels lower than other areas in the lake. Reports were that the mercury was related to power plants. Ms. Laura-Ashley Overdyke, CLI Executive Director, stated that there are fish mercury warnings. Mr. Kent Becher of the United States Geological Survey (USGS) explained that the source of mercury in the lake is airborne from coal-burning power plants all over east Texas and not LHAAP. Mr. Robert Lanier said he just wanted to know if he could eat the fish. Ms. Overdyke said the restrictions are still

in effect but that the mercury levels in the fish are going down and are expected to go down more based upon fish tissue sampling. Ms. Overdyke stated that it might help new attendees in the future to explain the purpose of the RAB meeting at the start of the meeting. Ms. Overdyke explained that the purpose of the meeting is to discuss the LHAAP cleanup with the RAB.

Mr. Lanier asked where the soil removed goes when it is excavated during a cleanup of a site and who governs and watches it. Ms. Zeiler explained that waste is governed by the Resource Conservation and Recovery Act (RCRA) and has to be disposed of at the proper facility. Ms. Zeiler stated that the Army and contractor watch to make sure the waste is classified and disposed of properly and that information is then reviewed by the TCEQ and USEPA. Ms. VanDeventer stated that she can attest that the disposal of soils is being watched based upon her many years on the RAB. Ms. VanDeventer explained that it is the RAB's role to ask questions and make sure that they get answered. Mr. Fortune said the question was a valid question and encouraged people that are interested to join the RAB to get the information out to the community.

Ms. Nemmers continued to discuss LHAAP completed field work by explaining that groundwater sampling is conducted as either remedial action-operations (RA-O) or performance sampling when listed. Groundwater monitoring means that water is collected from existing wells and that water is sent to offsite analytical laboratories for analysis. The groundwater data is then pulled into monitoring reports.

Repairs (i.e. soil placed where depressions were observed) were completed at LHAAP-19 landfill but will need to be repaired again (i.e. more soil placed and seeding completed) when things dry up more.

Ms. Nemmers explained that reports and work plans are used in the environmental industry to document activities. So, you will see that field work is followed by reports to document the work completed. The ROD and ESD for LHAAP-03 is being worked on to finalize these documents. The Pre-Design Investigation Report for LHAAP-17 will document the soil and groundwater results to support the design. A report is being prepared to document the remediation recently completed for LHAAP-58.

The 3 month look-ahead includes more sampling. Ms. Nemmers explained that, in addition, new monitoring wells and injection wells are being installed at LHAAP-16. The monitoring wells will further define the extent of groundwater contamination. The injection wells will be used to treat the groundwater contamination. Also, another shallow well is planned at LHAAP-17 to ensure that the groundwater contamination is fully defined.

LHAAP-58

Ms. Nemmers then discussed remediation at LHAAP-58, which primarily has chlorinated solvent contamination. The site has a decision document which means the remedy was selected. For LHAAP-58, the remedy selected was monitored natural attenuation which is essentially naturally occurring microbes in the groundwater that are able to use the contamination as a food source. After 2 years of monitoring, it was determined that more help was needed for the bacteria. The Eastern Plume was treated previously. In the past month, the Western Plume was also treated. During the baseline groundwater sampling, the bacteria needed to degrade the chlorinated

compounds were found to be naturally occurring. However, we added more bacteria during the treatment as well as a carbon substrate, which in this case was vegetable oil. Ms. Nemmers explained that the entire process implemented was to keep the bacteria happy in their new environment so that they will grow. The groundwater is monitored to ensure that the conditions are good for the bacteria, which are relatively new to the environmental cleanup industry.

Ms. Nemmers showed a map where the new monitoring wells were installed and stated that the downgradient monitoring well had fully defined the plume as no impacts were detected during the baseline groundwater sampling. Two mobilizations were completed for the treatment of the groundwater. The first injection was used to condition the aquifer to decrease the oxidation-reduction potential because the aquifer already had low dissolved oxygen. Prior to injection of the bacteria, monitoring was completed that confirmed the aquifer conditions were good. Ms. Nemmers then showed photos of the field work and explained how the injections are actually completed in the field. Ms. Nemmers explained that the drill rig is used to push tooling to the point we want to inject and then pulled up to the point we stop injecting. For LHAAP-58, the depth that the direct push was completed to was 30 feet below the ground and was pulled up to 20 feet below ground. This process is called bottoms up approach to an injection. Ms. Nemmers explained that quantities of all of the injections are measured. Emulsified vegetable oil (EVO) was selected as the substrate, which was then diluted prior to injecting. The water used to dilute the EVO was deoxygenated, which means that all of the oxygen is pulled out of the water. Mr. Rich Mayer asked what was used to deoxygenate the water. Ms. Nemmers stated that sodium sulfite was used, which takes 20 minutes to 2 hours to deoxygenate the water. Ms. Nemmers stated that when the bacteria was added, KB-1 Primer® was used by the company that provided the bacteria. The reason for using the KB-1 Primer® is that too much sodium sulfite can kill off the bacteria but the KB-1 primer limits sodium sulfite and has amino acids to scavenge the reduction potential. Ms. Nemmers explained that everything we do is to keep the bacteria happy.

Mr. Fortune asked if this was a similar approach to the Chem Lab. Ms. Zeiler stated that it was but the bioremediation was aerobic at the Chem Lab. So, the approach is similar but that oxygen was needed for the process.

Ms. Zeiler pointed out that each circle in the rows on the slide represented an injection point. Each point has the same process Ms. Nemmers discussed.

Mr. Fortune asked if the process was new. Ms. Nemmers explained that it is commonly used in the industry but was not introduced until about 10 years ago. The bacteria was found accidentally in wastewater treatment. Ms. Nemmers explained that the treatment does not require direct contact initially with the contamination as the bacteria will eventually treat the chlorinated solvents as they grow and move.

LHAAP-16

Mr. Bill Foss explained that there is contamination in two different aquifer zones at Site 16. Near Harrison Bayou, the shallow aquifer zone is about 5 feet below ground surface to 25 feet below ground surface when you get farther into the site. There is also an intermediate aquifer zone, which is 35 to 60 feet below ground surface. LHAAP-16 has chlorinated solvents, perchlorate,

and some metals present in the groundwater. Mr. Foss explained that a remedial design was approved in 2017 for in-situ bioremediation, similar to that presented for LHAAP-58. Currently, there is an extraction system operating for treatment of the groundwater.

Mr. Foss explained that a bromide tracer will be injected with the bioremediation solution at Site 16 to determine when the injections reach the extraction wells. Once the injections reach the extraction wells, they will be shut down and additional solution will be injected into the extraction wells. The current status is that the Remedial Design is approved and the Remedial Action Work Plan is prepared and is under review. The Remedial Design included the well locations so those are being installed in the field currently. No injections will be completed until the Remedial Action Work Plan is approved by the regulators and all of the wells are installed. The May/June date could be pushed out. Ms. Edmonds asked if the TCEQ and USEPA are involved. Mr. Foss confirmed that they will be reviewing everything.

Mr. Foss explained that the approach will use bacteria to treat the contamination. Ms. Overdyke asked about the injections focusing on the areas with the highest levels of contamination and questioned whether thought had been given to areas closest to the Bayou. Mr. Foss stated that a bio-barrier is being installed near the Bayou to address this concern. Shallow and intermediate zones are being treated. While the entire site is not being treated, Mr. Foss explained that the focus is to treat the hottest contamination and also to prevent impacts from entering the Bayou.

Ms. Edmonds asked if there was 2,4,6-trinitrotoluene (TNT) present at LHAAP-16. Mr. Foss stated that TNT was not a contaminant of concern. Ms. Zeiler stated that generally an investigation into the landfill contents is not performed, but releases from the landfill are assessed. No release of TNT has been identified. Mr. Mayer explained that investigation of a landfill can be dangerous since you don't know what is within the landfill itself. Ms. April Palmie stated that monitoring wells are present along the perimeter of the landfill to monitor groundwater. Both temporary and permanent wells are being installed with a total of 28 wells. The work started on Tuesday, April 17, and will take 2.5 to 3 weeks to be completed.

Groundwater Treatment Plant

Ms. Nemmers then discussed the GWTP slides and handouts provided. January 2018 was cold with freezing conditions which resulted in a decrease in the discharge. Also, Ms. Nemmers explained that dry weather eliminates our ability to discharge to the Bayou because there is not flow. So, treated water is discharged to the pond. However, February and March 2018 have an increase in the discharge volume because treated groundwater was discharged from both the GWTP and the pond to the Bayou.

Surface Water Sampling

Ms. Nemmers explained that surface water samples were collected as recently as March 2018, which is included in the graph. The bottom line is that the March 2018 results were non-detect. Any variations in the graphed line are due to the detection limits by the offsite analytical laboratory.

RAB Tour

Ms. Nemmers explained the different travel options for the tour. Ms. Nemmers presented the tour route and that handouts would be provided for each site when stopped. Ms. Overdyke asked if the tour would stop at each site, which Ms. Nemmers confirmed.

Next RAB Meeting Schedule and Closing Remarks

Ms. Zeiler then discussed the next meeting. The next RAB meeting will be held on **July 19, 2018,** with a **meeting starting at 6:00 pm CDT** at the Karnack Community Center, based upon input during the meeting. Mr. Lanier asked why this work is being done. Ms. Zeiler explained that the Army has the liability to clean up the site under the law. Ms. Zeiler also explained that leaving the sites as they are poses an unacceptable risk. Mr. Lanier asked if this risk was not known when the sites were active to which Ms. Zeiler confirmed that was the case. Mr. Lanier inquired whether work is being done to prevent the contamination from entering the lake, which Ms. Zeiler confirmed it was.

Ms. Zeiler explained that there is another contractor, HDR, who is working on Sites LHAAP-18/24, -29, and -47, the sites without final RODs. For LHAAP-29, the old TNT production lines, the proposed plan and ROD are being revised. The plan is to have the proposed plan out to the public in September 2018 for review and comment. LHAAP-18/24 had screening sampling completed to gather more data, which helped in completion of the Feasibility Study. Now the proposed plan for LHAAP-18/24 is being prepared and refined. The Proposed Plan is where the remedy is selected. LHAAP-47 has a draft final ROD but Army felt that new data had to be collected because the existing data was old and there were too many dry wells. A Pre-Design Investigation is being conducted to collect the new data. LHAAP-47 has a final Proposed Plan, which should not need to change.

Ms. Zeiler discussed the transfer of property under Environmental Condition of Property (ECP) VII which includes the two Military Munitions Response Program (MMRP) ranges (80 acres a piece), demolition debris landfill (about 13 acres), and the pistol range (about 1 acre). The ECP VII is under Army review and will then be sent to the United States Fish and Wildlife Service (USFWS) for review. EPA will also be asked to review, as will TCEQ. Mr. Fortune asked approximately how many acres are left. Ms. Zeiler stated that there were a little over 1,000 acres with most of that tied up in the production areas, including the GWTP and the sites that feed into that treatment plant. The transfer of the four sites will bring the transferred acreage up to approximately 85-percent of the LHAAP footprint. She also added that additional surface water rights will be transferred to USFWS.

Mr. Lanier asked where the funds come from and who controls the funds. Mr. Andrew Maly then discussed the funding approved by Congress and given to the USAEC to control and allocate. Mr. Maly explained the Environmental Restoration Account. Mr. Maly stated it is centrally funded but the recent continuing resolutions has caused issues with funding. Ms. Zeiler stated that LHAAP has not been impacted by funding issues.

Adjourn

Ms. VanDeventer motioned to adjourn. Mr. Tom Walker seconded the motion. Meeting adjourned at 5:01 pm CDT.

April 2018 Meeting Attachments and Handouts:

- Meeting Agenda
- Color Copy of Bhate Presentation Slides
- Groundwater Treatment Plant (GWTP) – Processed Groundwater Volumes Handout

LONGHORN ARMY AMMUNITION PLANT
RESTORATION ADVISORY BOARD
Karnack, Texas
(479) 635-0110

AGENDA

DATE:	Thursday, April 19, 2018
TIME:	4:00 – 5:00 PM
PLACE:	Karnack Community Center, Karnack, Texas

04:00 **Welcome and Introduction**

04:05 **Open Items {RMZ}**
- RAB Administrative Issues
- Minutes (January 2018 RAB Meeting)
- Ongoing Outreach/Website

04:15 **Defense Environmental Restoration Program (DERP) Update {Bhate}**
- Documents and Field Work Completed in 1st Quarter 2018
- Three Month Lookahead
- LHAAP-58 Contingent Remedy Implementation
- LHAAP-16 Remedial Action
- Groundwater Treatment Plant (GWTP) Update
- Overview of Tour that will follow the RAB

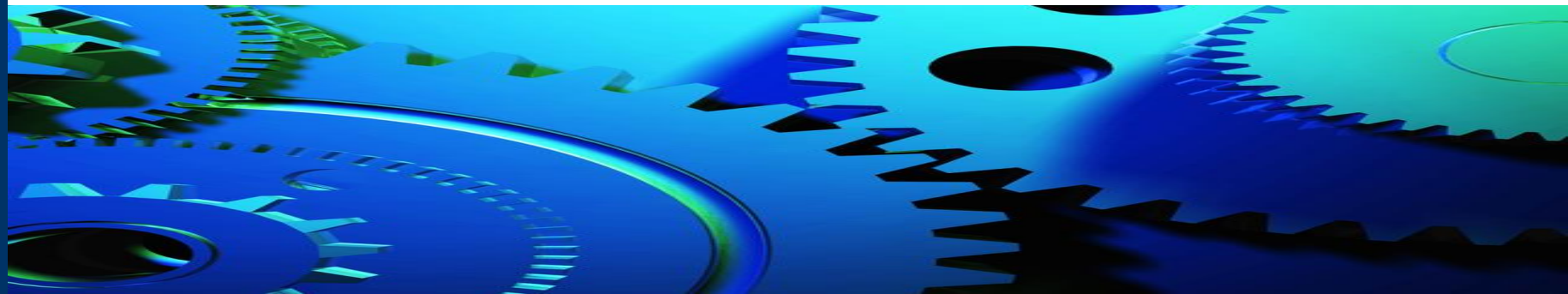
04:45 **Environmental Restoration Issues {RMZ}**
- Update on LHAAP Sites -18/24, -29 and -47

04:50 **Next RAB Meeting Schedule and Closing Remarks {RMZ}**

05:00 **Tour of LHAAP (**Participants to drive their own vehicles or carpool**)**

Longhorn Army Ammunition Plant Quarterly Restoration Advisory Board Meeting

Karnack Community Center
April 19, 2018
4:00 PM CDT



Restoration Advisory Board (RAB) Meeting

Agenda

04:00	Welcome and Introduction
04:05	Open Items
-	RAB Administrative Issues
-	Minutes (January 2018 RAB Meeting)
-	Ongoing Outreach/Website
04:15	Defense Environmental Restoration Program (DERP) Update {Bhate}
-	Documents and Field Work Completed
-	Three Month Look Ahead
-	LHAAP-58 Contingent Remedy Implementation
-	LHAAP-16 Remedial Action
-	Groundwater Treatment Plant (GWTP) Update
-	Overview of Tour that will follow the RAB
04:45	Environmental Restoration Issues
	- Update on LHAAP Sites -18/24, -29, and -47
04:50	Next RAB Meeting Schedule and Closing Remarks
05:00	Tour of LHAAP (Participants to drive their own vehicles or carpool)

Abbreviations and Acronyms

µg/L	micrograms per liter
DERP	Defense Environmental Restoration Program
DF	Draft Final
EISB	Enhanced in-situ bioremediation
ERD	Enhanced reductive dechlorination
ESD	Explanation of Significant Difference
EW	extraction well
ft bgs	feet below ground surface
GWTP	groundwater treatment plant
ISB	In-situ bioremediation
IW	injection well
LHAAP	Longhorn Army Ammunition Plant
MNA	monitored natural attenuation
MW	monitoring well
RAB	Restoration Advisory Board
RA-O	Remedial Action - Operation
RACR	Remedial Action Completion Report
RAWP	Remedial Action Work Plan
RD	Remedial Design
ROD	Record of Decision
RTC	response to comment

RAB Administrative Issues

RAB Membership

RAB Tour

Minutes from Past RAB Meetings

Discussion of January 2018 RAB Meeting minutes/motion to accept

The Army Wants You to be Informed

- The Army is committed to protecting human health and the environment; key to that commitment is engaging the community and increasing public participation in environmental restoration at LHAAP

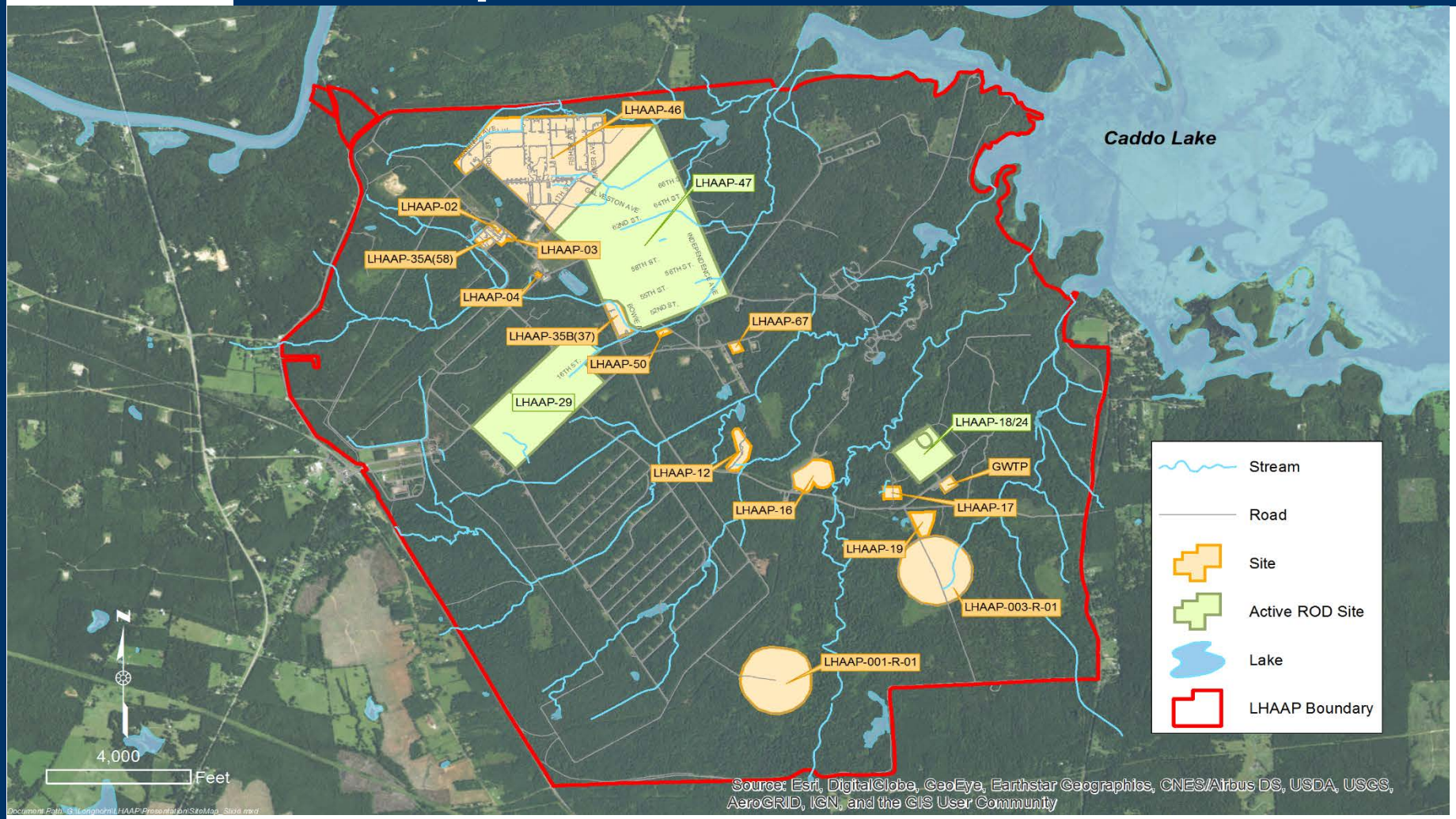
- You are encouraged to:
  - Attend RAB Meetings and/or become a member of the RAB
  - Visit the Longhorn environmental website at www.longhornaap.com
  - Make suggestions for improving communication – the Army welcomes and appreciates community feedback

Outreach

- Website Address: http://www.longhornaap.com/
- Website will be updated to indicate the upcoming field events at each site including groundwater sampling, monitoring well installations, soil sampling, or remediation activities

Restoration Advisory Board Meeting

Site Map



Documents in Process

Site	Document
Basewide	Installation Wide Work Plan
LHAAP-03	Response to Comment (RTC) – Draft Final (DF) Record of Decision (ROD)
LHAAP-03/58	Explanation of Significant Difference (ESD) to address groundwater under LHAAP-03
LHAAP-12	Annual Remedial Action – Operation (RA-O) Report
LHAAP-16	Remedial Action Work Plan (RAWP)
LHAAP-17	Pre-Design Investigation (PDI) Report
LHAAP-50	Year 3 RA-O Report
LHAAP-58	ESD, Year 3 RA-O Report
GWTP, LHAAP-18/24 and Surface Water	Quarterly Evaluation Report Fourth Quarter (October – December) 2017

Completed Field Work

Site	Activity
LHAAP-04	Installed new wells (Dec 2017) and sampled all wells (Jan 2018)
LHAAP-12	RA-O Sampling – December 2017
LHAAP-16	Compliance groundwater sampling – February 2018
LHAAP-17	PDI – Sampled Existing Groundwater Wells (Nov 2017), installed shallow well (Dec 2017) and piezometers, initiated soil sampling (Jan 2018)
LHAAP-19	Repairs to landfill cap
LHAAP-37	RA-O Sampling – February 2018
LHAAP-46	RA-O Sampling – February 2018
LHAAP-58	Baseline Groundwater Sampling and Enhanced Reductive Dechlorination (ERD) Injections
LHAAP-67	RA-O Sampling – December 2017
Surface Water	Surface Water Sampling – March 2018

3 Month Look Ahead - Documents

Site	Document
LHAAP-03	RTC – DF ROD
LHAAP-03/58	ESD
LHAAP-12	Annual RA-O Report for 2017 (Year 3)
LHAAP-16	RAWP
LHAAP-17	PDI Report
LHAAP-50	Year 3 RA-O Report
LHAAP-58	Remedial Action Completion Report (RACR)
GWTP, LHAAP-18/24, LHAAP-16, Surface Water	Quarterly Evaluation Reports: Fourth Quarter (October –December) 2017 and First Quarter (January – March) 2018

3 Month Look Ahead - Field Work

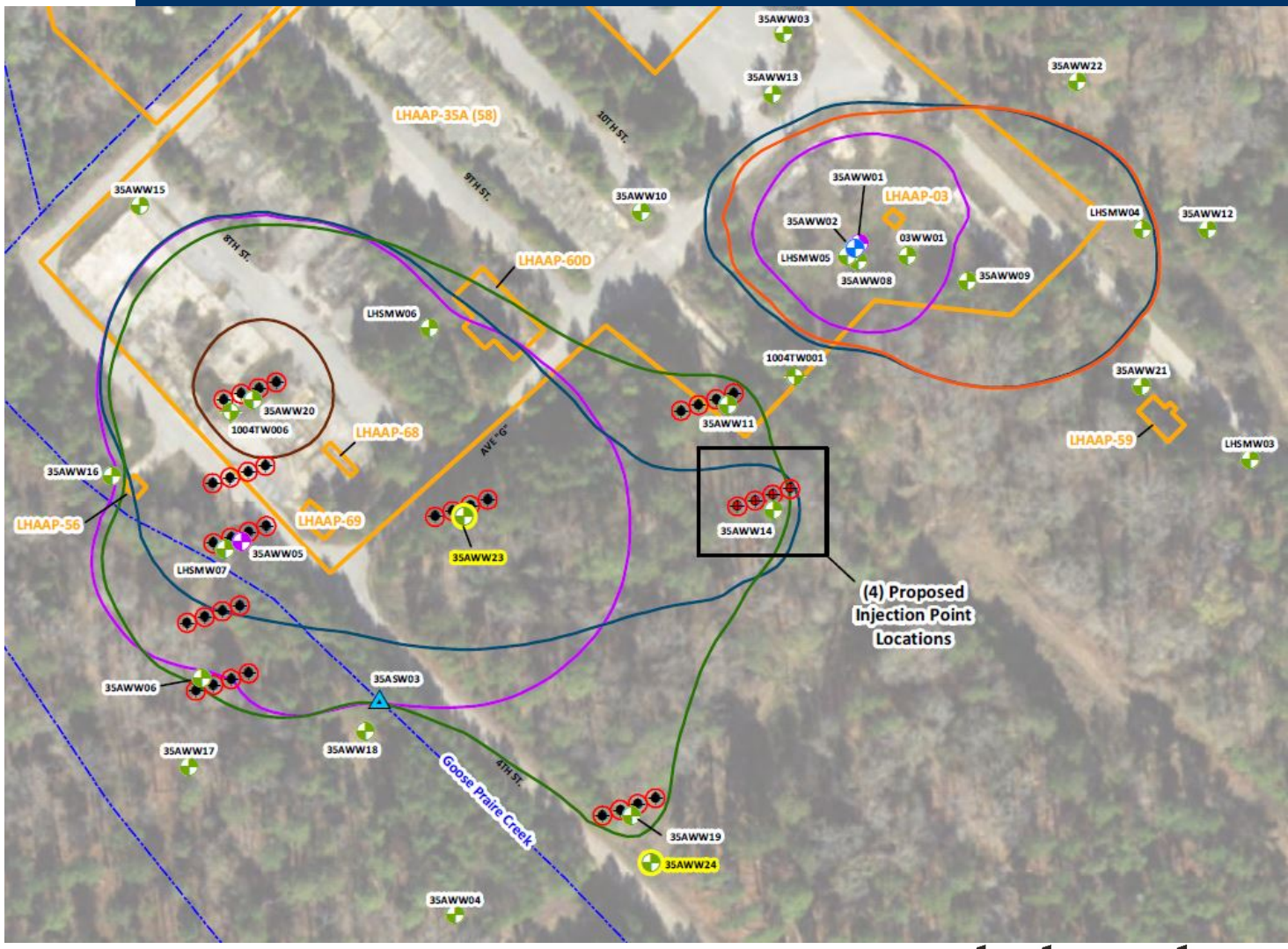
Site	Activity
LHAAP-02	Groundwater Sampling - April 2018
LHAAP-16	Monitoring well and injection well installation, pre-remedy groundwater sampling, in-situ bioremediation (ISB) injections – April to June 2018
LHAAP-17	PDI – If site conditions dry up - complete soil sampling; install additional shallow well and complete additional groundwater sampling
LHAAP-18/24	RA-O Sampling
LHAAP-37	RA-O Sampling – May 2018
LHAAP-50	RA-O Sampling – May 2018
LHAAP-58	RA-O Sampling
LHAAP-67	RA-O Sampling – May 2018
Surface Water	Collect Surface Water samples

LHAAP-58: Shops Area, Group 3

- Shallow zone groundwater is impacted with volatile organic compounds (VOCs)
  - Groundwater plume has two distinct areas: eastern plume and western plume
- Soil poses no unacceptable threat to human health or the environment
- 2018 Contingency Remedy Implemented – Western Plume
  - Monitored natural attenuation (MNA) remedy for the western plume, as presented in the ROD, calls for an evaluation of the remedy after 2 years
    - ROD provides for implementation of a contingency remedy to enhance MNA if MNA is found to be ineffective
    - RA-O implementation was completed between October 2013 and October 2015 and the 2nd year RA-O report was finalized in May 2016
    - After 2 years of MNA, the 2nd year RA-O report concluded that MNA is ineffective and implementation of a contingency remedy is appropriate
    - Contingency Remedy is enhanced in-situ bioremediation (EISB) for the western plume

Restoration Advisory Board Meeting

LHAAP-58: Contingent Remedial Action



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Restoration Advisory Board Meeting

LHAAP-58: Contingent Remedial Action

LHAAP-58: Current Status

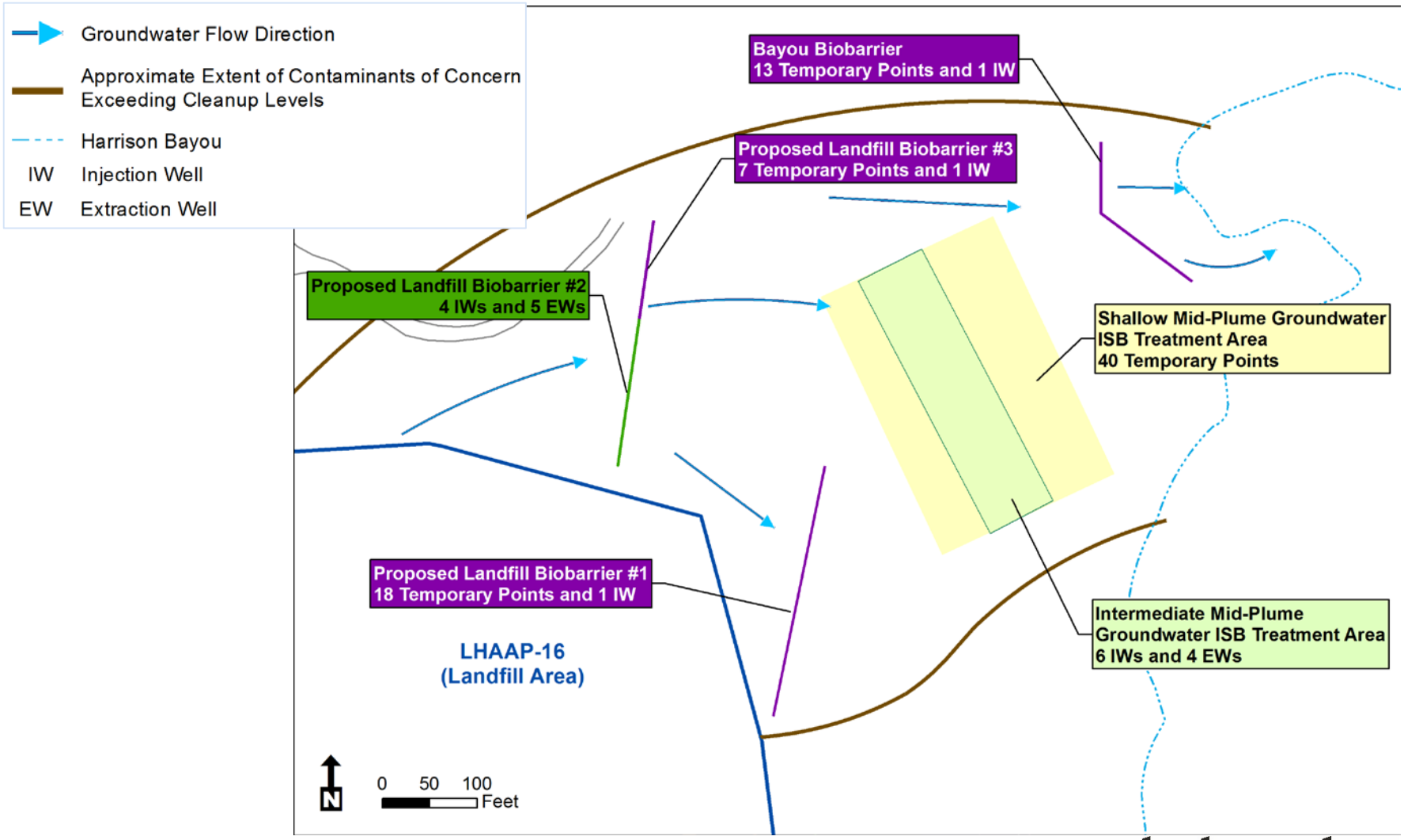
- Completed Contingent Remedy
  - Emulsified Vegetable Oil
  - Bacteria added for bioaugmentation
- Semi-Annual RA-O sampling planned for June 2018

LHAAP-16: Remedial Action

- Site conditions
  - LHAAP-16 is a capped landfill approximately 20 acres
  - Groundwater plumes are present in shallow zone (4 feet below ground surface [ft bgs] near Harrison Bayou to 25 ft bgs near landfill) and intermediate zone (35 to 62 ft bgs)
  - Contaminants include chlorinated volatile organic compounds, perchlorate, and metals
  - Groundwater flow is towards Harrison Bayou
- Status
  - Remedial Design (RD) approved in January 2017 for ISB
  - RAWP is in comment resolution phase with the regulators
  - Installation of additional monitoring wells and injection wells – April - May 2018
  - Begin injections – May/June 2018
- ISB
  - ISB injections and phased shutdown of existing extraction system
  - Performance monitoring will be conducted for 2 years post injections
  - The ISB is focused on areas of the highest concentrations and is expected to reduce concentrations to allow the remaining plume areas to naturally attenuate after injections
  - After performance monitoring, it will be determined if MNA is a viable remedy for the remaining plume

Restoration Advisory Board Meeting

LHAAP-16 Remedial Action

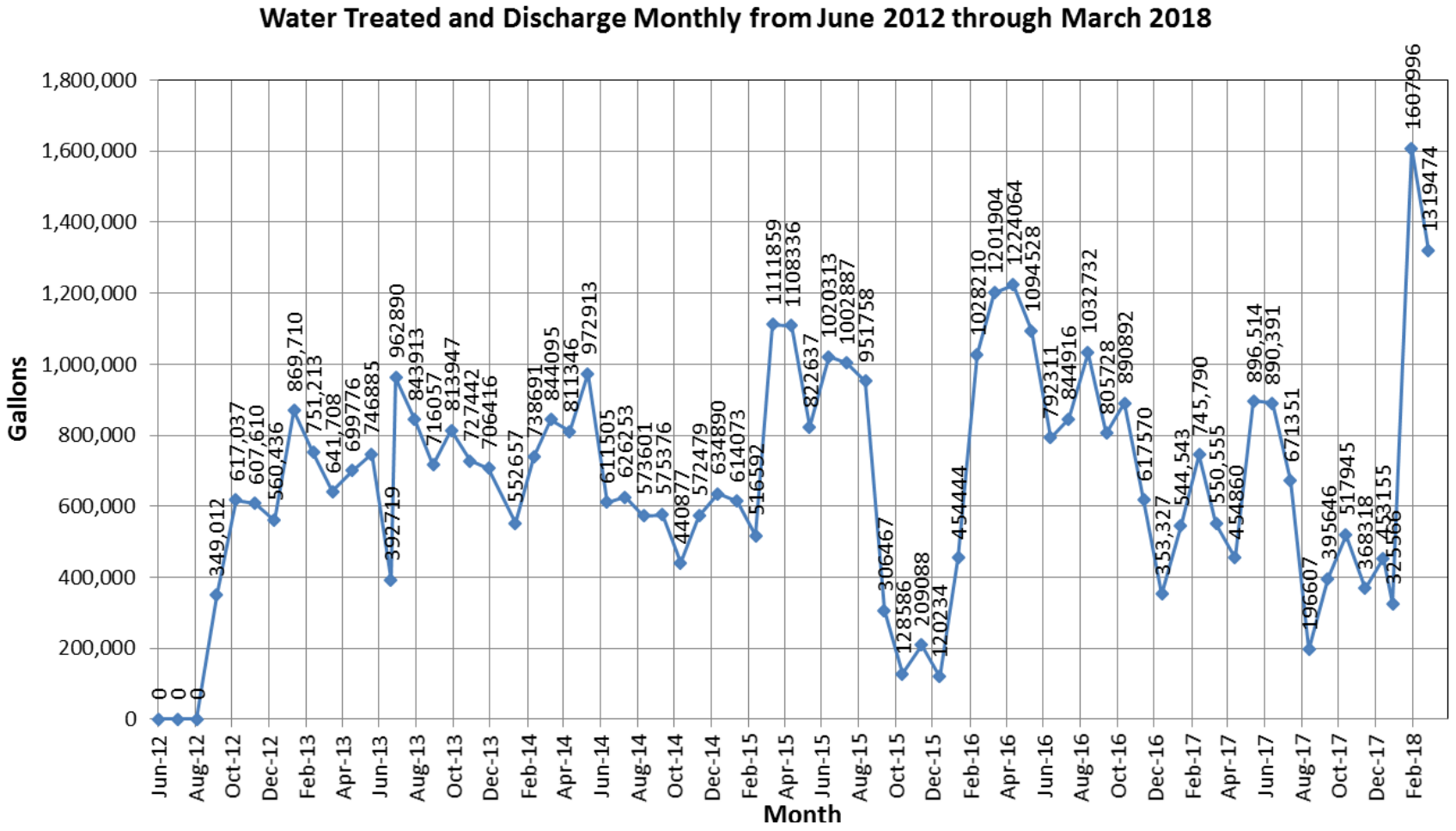


LHAAP-16: ISB Remedial Action

- ISB (Contd)
  - Injection of carbon sources (emulsified vegetable oil) and bacteria for biougmentation to enhance aquifer conditions for reductive dechlorination to reduce volatile organic and perchlorate concentrations
  - Injection mixture will consist of water, emulsified vegetable oil, bacteria, nutrients, and a tracer
  - Additionally, iron will be added to the injection mixture at the Bayou Biobarrier
  - Some locations use temporary injection points that use direct push technology
  - Other locations use injection wells (existing or new) and extraction wells (existing)
  - Where there are extraction wells, the extraction system will be used to help distribute the injected material by using the tracer. Once distributed, the extraction will be turned off and the extraction wells will be used for injections.

Restoration Advisory Board Meeting

GWTP Update



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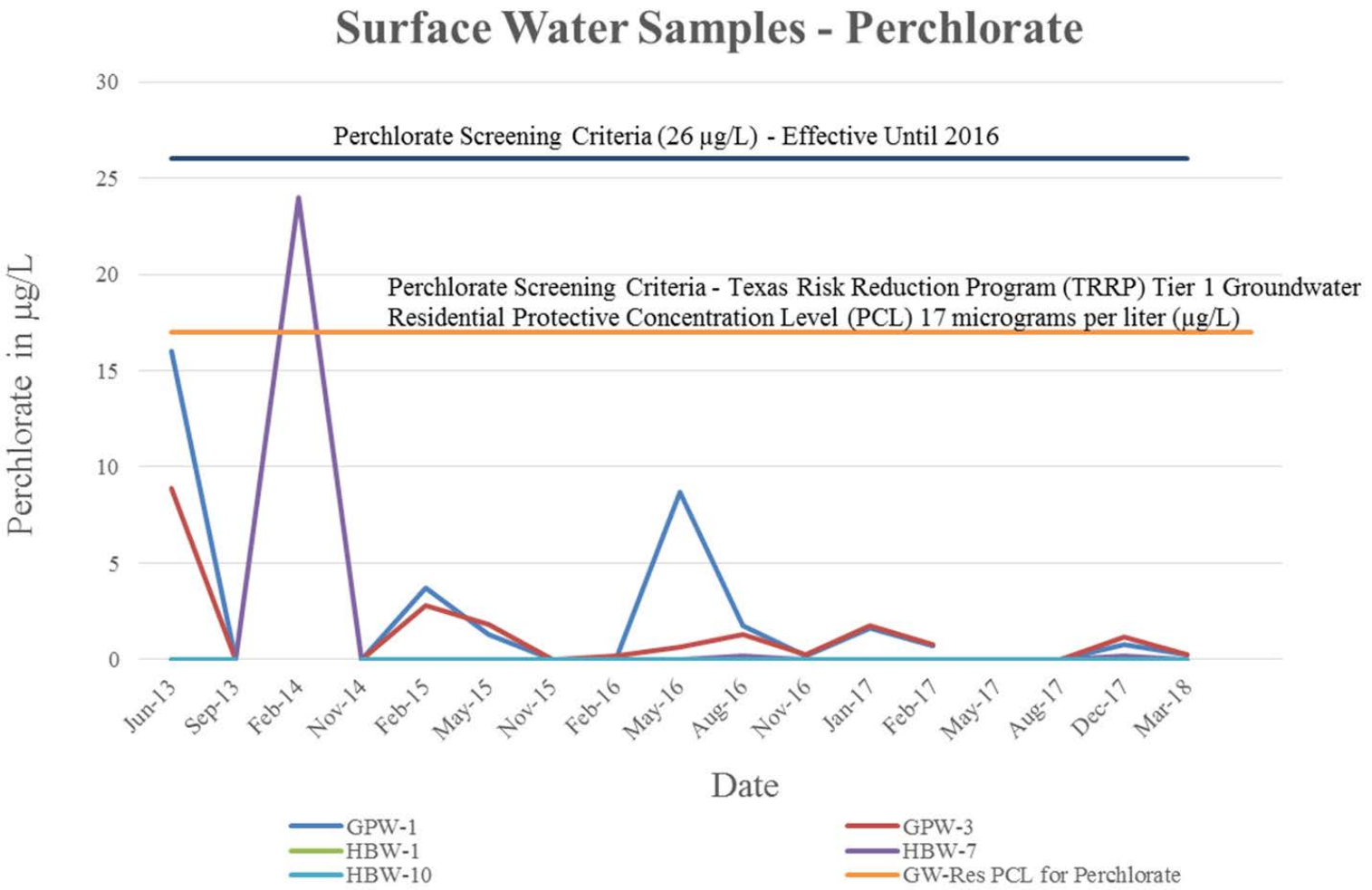
Surface Water Sample Results



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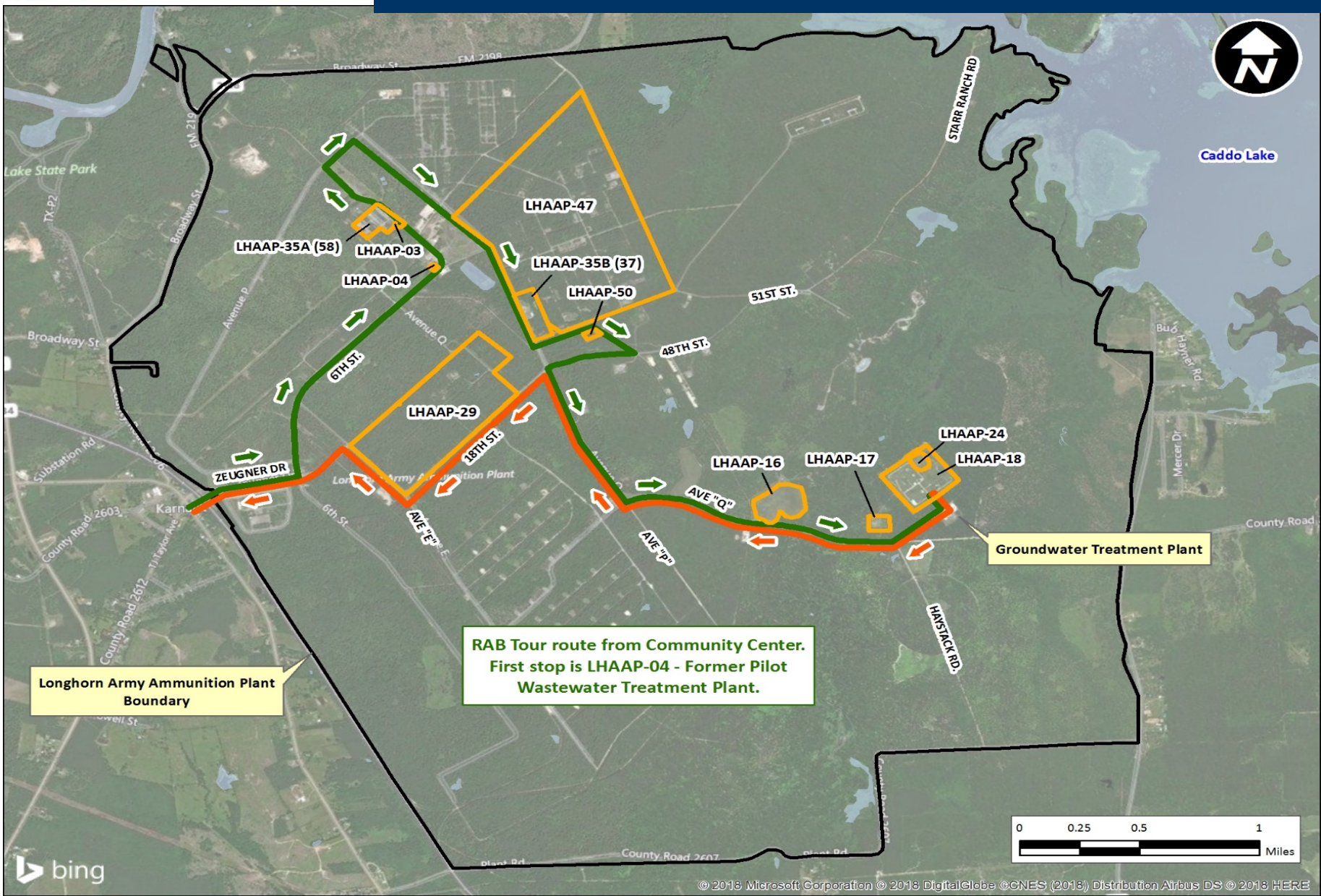
Restoration Advisory Board Meeting

RAB Site Tour



Next RAB Meeting Schedule & Closing Remarks

- Schedule July 2018 RAB Meeting
- Other Issues/Remarks
- LHAAP Tour

Groundwater Treatment Plant - Processed Groundwater Volumes

The amount of groundwater treated is determined by measuring the number of gallons of processed water.

Processed Water Data

(in gallons)

Oct-07	Nov-07	Dec-07	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08
1,041,491	848,356	804,822	792,148	665,883	818,872	791,306	568,812	776,904	748,377	690,052	617,199

Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09
655,059	619,274	726,118	552,299	598,144	433,800	488,807	526,958	387,644	0	414,853	735,716

Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10
808,322	636,306	727,492	391,898	695,343	802,656	894,731	962,121	1,257,977	1,314,924	1,041,495	1,136,547

Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11
956,567	705,805	849,712	811,679	668,281	1,090,348	817,325	900,338	916,552	784,369	652,524	733,456

Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12
748,102	658,250	684,903	865,453	725,000*	730,000*	980,000*	630,000*	0	0	0	349,012

Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13
617,037	607,610	560,436	869,710	751,213	641,708	699,776	746,885	962,890	843,913	716,057	813,947

Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14
727,442	766,416	552,657	738,691	844,095	811,346	972,913	611,505	626,253	573,601	575,376	440,877

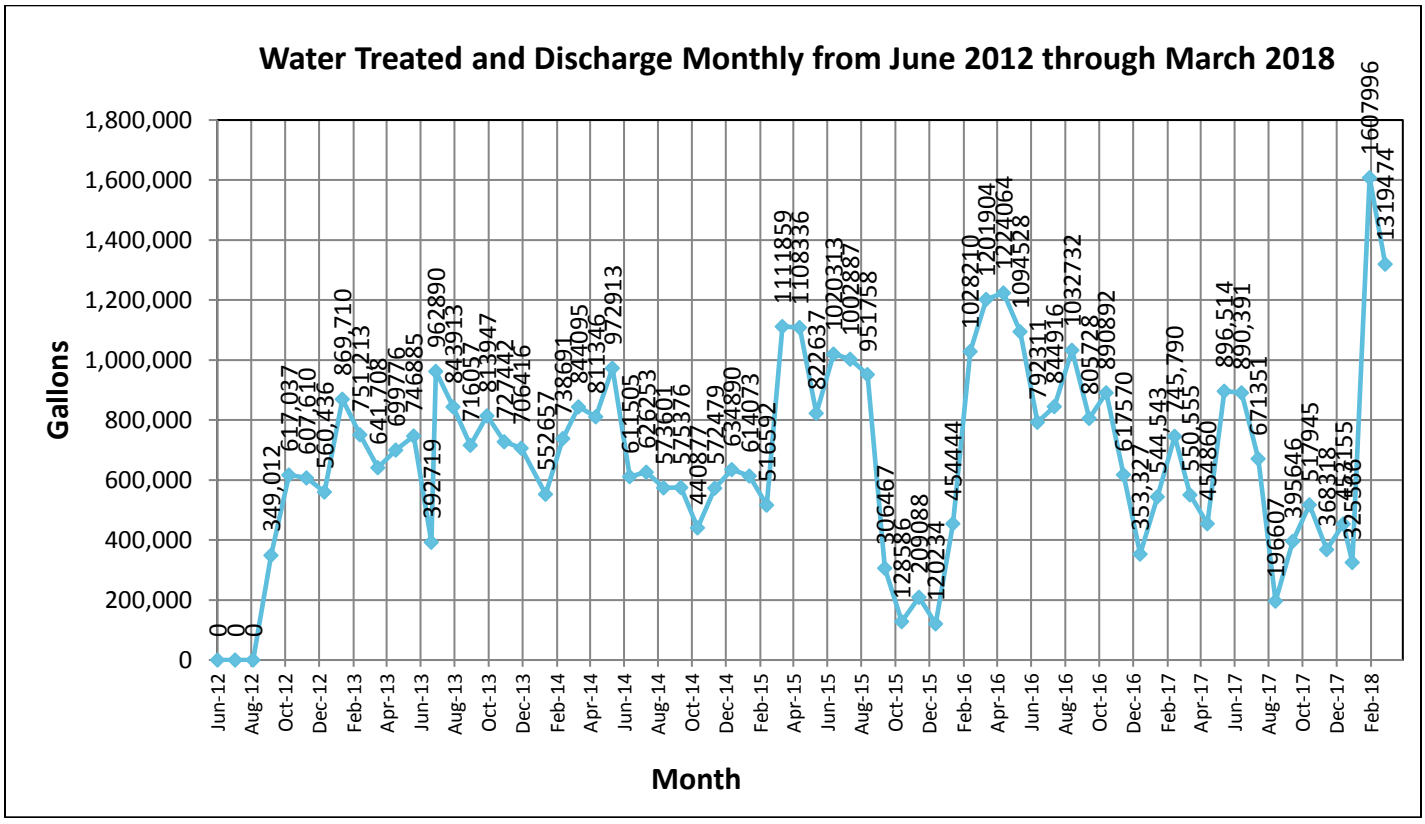
Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15
572,479	634,890	614,073	516,592	1,111,859	1,108,336	822,637	1,020,313	1,002,887	951,758	306,467	306,467

Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16
128,586	209,088	120,234	454,444	1,028,210	1,201,904	1,224,064	1,094,528	792,311	844,916	1,032,732	805,728

Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17
890,892	617,570	353,327	544,543	745,790	550,555	454,860	896,514	890,391	528,538	195,198	961,324

Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18
517,945	368,318	453,155	325,566	1,607,996	1,319,474

*Indicates Estimate



Water Discharge Location and Volume (Gallons)

Month	Harrison Bayou	LHAAP-18/24 Sprinklers	INF Pond	INF Pond to Harrison Bayou	Contract Hauled Off-Site
Dec-16	0	236,688	0	0	0
Jan-17	0	0	0	0	0
Feb-17	0	0	0	0	14,355
Mar-17	127,242	0	0	0	14,400
Apr-17	113,038	0	236,821	0	0
May-17	205,665	0	534,155	0	0
Jun-17	467,830	0	294,550	490,574	0
Jul-17	0	0	528,538	0	0
Aug-17	0	0	195,197	0	0
Sep-17	0	0	309,980	651,434	0
Oct-17	0	0	517,945	0	0
Nov-17	0	0	368,318	0	0
Dec-17	0	0	453,155	560,350	0
Jan-18	325,566	0	253,177	325,566	0
Feb-18	1,607,996	0	62,017	1,430,634	0
Mar-18	1,319,474	0	0	870,816	0

Harrison Bayou and Goose Prairie Creek – Perchlorate Data

Surface water samples are collected quarterly from each location in Harrison Bayou and Goose Prairie Creek, unless the sampling location is dry.

Surface Water Sample Data (in micrograms per liter)

Quarter	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st
Creek Sample ID	**Jul 1999**	**Sep 1999**	**Feb 2000**	**Apr 2000**	**Aug 2000**	**Dec 2000**	**Feb 2001**	**Apr 2001**	**July 2001**	**Oct 2001**	**Jan 2002**
GPW-1	<1.0U	-	4	<4.0 U	<4.0 U	<4.0 U	-	2.65	<4.0 U	<4.0 U	<4.0 U
GPW-3	<1.0U	<4.0 U	17	8	<4.0 U	<4.0 U	-	2.28	<4.0 U	<4.0 U	<4.0 U
HBW-1	-	<80.0 U	310	23	-	-	<4.0 U	-	<4.0 U	<4.0 U	<4.0 U
HBW-7	-	<8.0 U	370	110	-	-	<4.0 U	-	<4.0 U	<4.0 U	<4.0 U
HBW-10	-	<8.0 U	905	650	<4.0 U	-	<4.0 U	-	<4.0 U	-	-

Quarter	2nd	3rd	4th	1st	2nd	3rd	3rd	4th	2nd	3rd	4th
Creek Sample ID	**June 2002**	**Sept 2002**	**Dec 2002**	**Feb 2003**	**June 2003**	**Aug 2003**	**July 2004**	**Dec 2006**	**May 2007**	**Aug 2007**	**Dec 2007**
GPW-1	<4.0 U	<4.0 U	18.3	18.6	59.9	-	2.25	-	<1.0 U	<1.0 U	10.7
GPW-3	<4.0 U	<4.0 U	5.49	12.6	14.7	-	2.2	-	<1.0 U	<1.0 U	7.48
HBW-1	<4.0 U	<4.0 U	<4.0 U	-	<4.0 U	99.3	<0.2U	<1.0 U	<1.0 U	122	<1.0 U
HBW-7	<4.0 U	<4.0 U	<4.0 U	-	<4.0 U	<4.0 U	<0.2U	<1.0 U	<1.0 U	1.02	<1.0 U
HBW-10	<4.0 U	<4.0 U	<4.0 U	-	<4.0 U	-	<0.2U	<1.0 U	<1.0 U	<1.0 U	<1.0 U

Quarter	1st	2nd	3rd	4th	2nd	3rd	3rd	3rd	4th	1st	2nd
Creek Sample ID	**Mar 2008**	**Jun 2008**	**Sep 2008**	**Dec 2008**	**May 2009**	**Jul 2009**	**Aug 2009**	**Sep 2009**	**Dec 2009**	**Mar 2010**	**Jun 2010**
GPW-1	27	<0.5U	<0.5U	<0.22U	16	<4U	NS	<1.2U	3.7	1.3J	<0.6U
GPW-3	21.9	9.42	1.1	<0.22U	8.9	<4U	NS	<0.6U	2.8	1.8J	<0.6U
HBW-1	<0.5U	<0.5U	<0.5U	<0.22U	<0.55U	<4U	NS	<1.5U	<0.275U	1.5U	<0.6U
HBW-7	<0.5U	<0.5U	<0.5U	<0.22U	<0.55U	<4U	24	<1.2U	<0.275U	1.5U	<0.6U
HBW-10	<0.5U	<0.5U	<0.5U	<0.22U	<0.55U	<4U	NS	<1.5U	<0.275U	1.2U	<0.6U

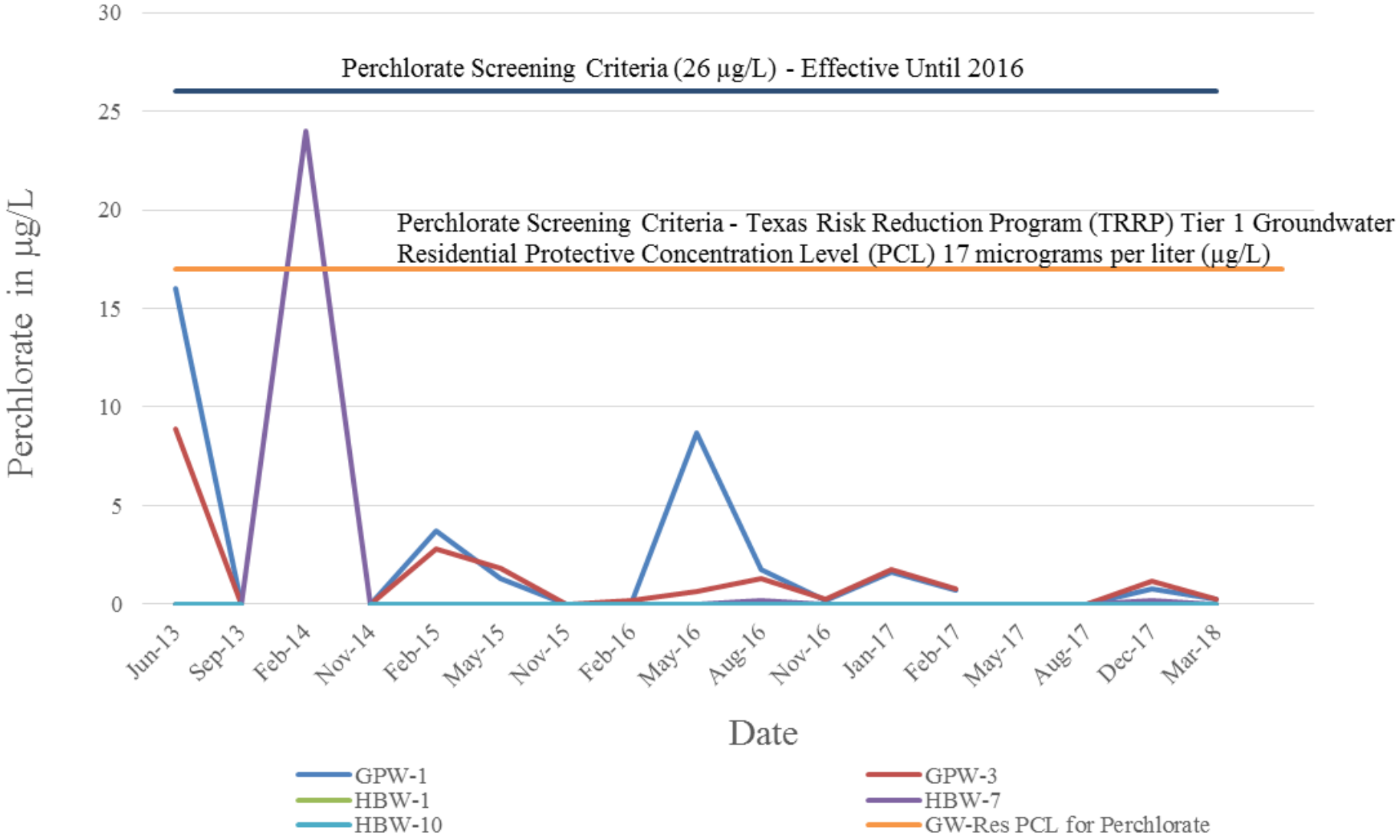
Quarter	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st
Creek Sample ID	**Sep 2010**	**Dec 2010**	**Mar 2011**	**Jun 2011**	**Sep 2011**	**Dec 2011**	**Mar 2012**	**Jun 2012**	**Not Applicable**	**Jan & Feb 2013**	**Mar 2013**
GPW-1	dry	<0.1U	8.7	dry	dry	1.76	0.163J	dry	NS	1.65	0.735
GPW-3	dry	0.199J	0.673	dry	dry	1.31	0.261	dry	NS	1.74	0.754
HBW-1	dry	<0.1U	<0.2U	dry	dry	<0.1U	0.1U	dry	NS	<0.2U	<0.2U
HBW-7	dry	<0.1U	<0.2U	dry	dry	0.171J	0.1U	dry	NS	<0.2U	<0.2U
HBW-10	dry	<0.1U	<0.2U	dry	dry	<0.1U	0.1U	dry	NS	<0.2U	<0.2U

Quarter	2nd	3rd	4th	1st	2nd	3nd	4th	1st	2nd	3rd	4th
Creek Sample ID	**Jun 2013**	**Sept 2013**	**Dec 2013**	**Feb 2014**	**May 2014**	**Aug 2014**	**Nov 2014**	**Feb 2015**	**May 2015**	**Aug 2015**	**Nov 2015**
GPW-1	dry	<0.2 U	dry	0.766	dry	dry	0.244 J	0.311 J	0.156J	dry	0.142 J
GPW-3	dry	<0.2 U	dry	1.15	dry	dry	0.276 J	0.344 J	dry	dry	0.311 J
HBW-1	<0.2U	<0.2 U	dry	<0.2 U	dry	dry	<0.2 U	<0.2 U	dry	dry	<0.2 U
HBW-7	<0.2U	<0.2 U	dry	0.201 J	dry	dry	<0.2 U	0.124 J	dry	dry	<0.2 U
HBW-10	<0.2U	<0.2 U	dry	<0.2 U	dry	dry	<0.2 U	<0.2 U	dry	dry	<0.2 U

Quarter	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st
Creek Sample ID	**Feb 2016**	**May 2016**	**Aug 2016**	**Nov 2016**	**Feb 2017**	**May 2017**	**Aug 2017**	**Dec 2017**	**March 2018**
GPW-1	0.447	6.59	<0.2 U	0.301 J	<1 U	0.263	dry	<4.0 U	<4.0 U
GPW-3	0.474	0.457	0.141	0.563	<1 U	0.274	dry	<4.0 U	<4.0 U
HBW-1	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<1 U	<0.2 U	<0.2 U	1.1 J	<4.0 U
HBW-7	<0.2 U	<0.2 U	<0.2 U	0.318 J	<1 U	0.155	<0.2 U	<4.0 U	<4.0 U
HBW-10	<0.2 U	<0.2 U	<0.2 U	<0.2 U	<1 U	<0.2 U	0.111J	<4.0 U	<4.0 U

NS – not sampled U – non-detect J – Estimated Dry – no surface water

Surface Water Samples - Perchlorate



Longhorn Army Ammuntion Plant Creek Sampling Locations